

A scenic view of a river with rapids flowing through a dense forest. The water is turbulent and white with foam as it cascades over rocks. The surrounding trees are lush green, and the overall atmosphere is natural and serene.

ARE WE USING ALL OF THE INFORMATION AVAILABLE TO ESTIMATE STREAMFLOW?

By

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Snowcap Hydrology

DATA

- **Need Complete Data Set**
 - **Get Missing Data Sheets**
 - **Estimate Missing Data**
 - **There Should Be One Dataset That Everyone Could Use**

ONE PICTURE

A scenic photograph of a snowy mountain landscape. In the foreground, there are several evergreen trees heavily laden with snow. The middle ground shows a valley with more snow-covered trees and a few small buildings. In the background, a large, snow-capped mountain peak rises against a clear blue sky. The overall scene is peaceful and wintry.

- **Presentation Of Data For Mountains And Valleys Need To Be Seamless**
- **The Days Of Them And Us Need To Be Part Of History**

KBDI

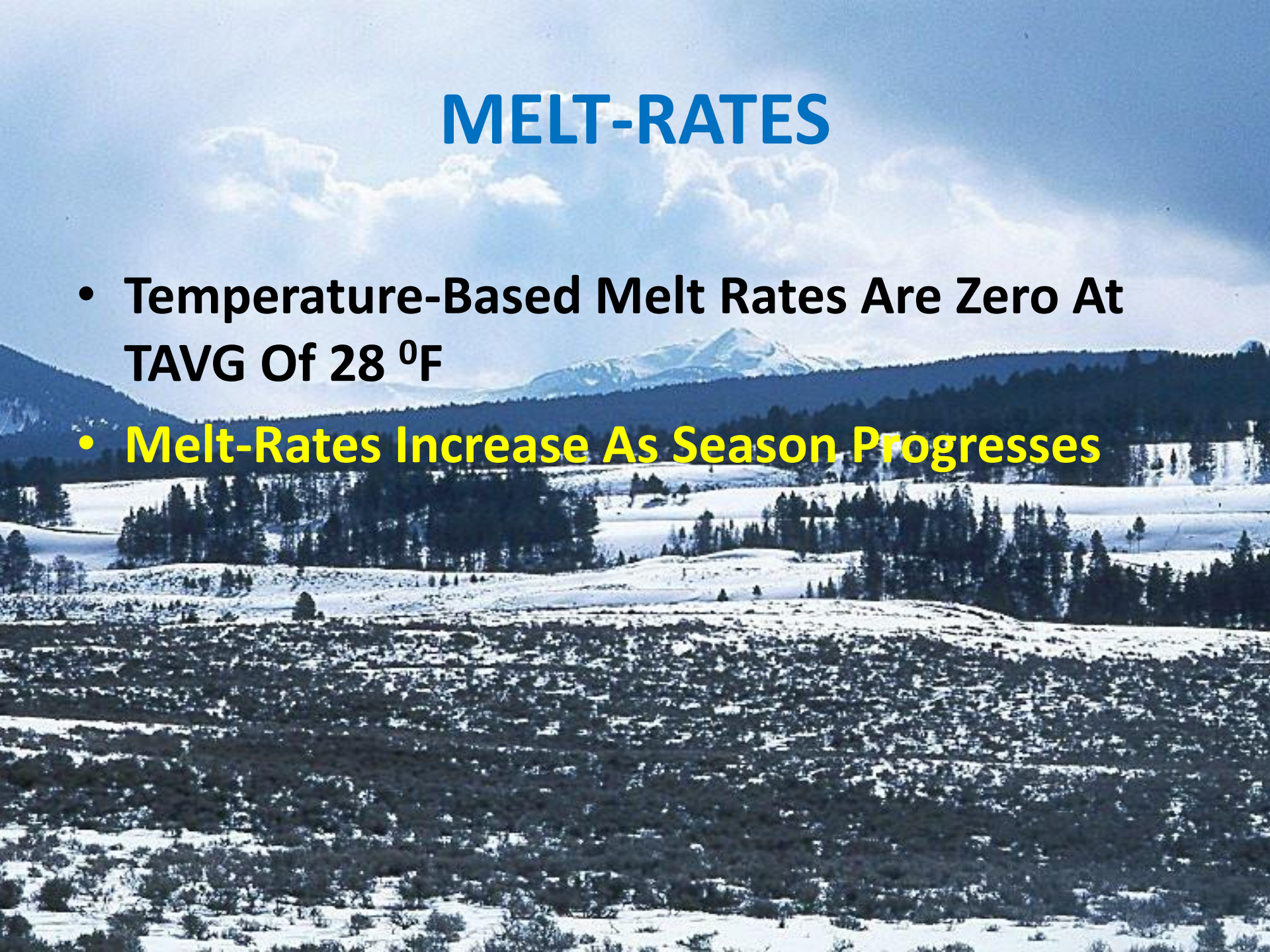
- *Compute KBDI for both SNOTEL and Climatological Stations*
- *Provides Current Daily Status Of Soil Moisture*
- *Provides Precipitation Needed To Erase Deficit*
- *Used By Fire Managers*
- *Could Be Used By Many Disciplines*

DATES

- **Hydrology Is Based On Phenological And Hydrologic dates, Not Calendar Dates**

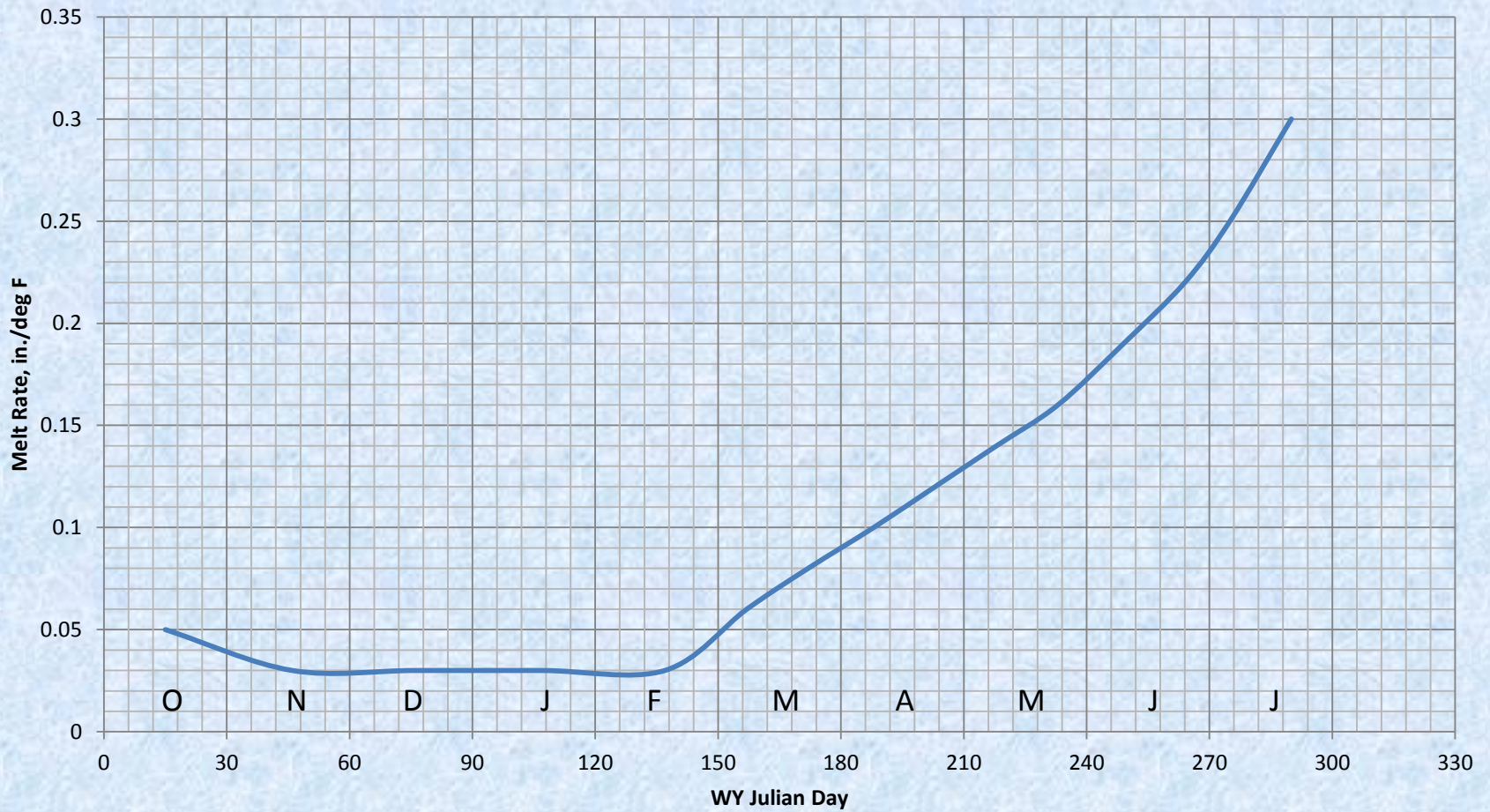
MELT-RATES

- Temperature-Based Melt Rates Are Zero At TAVG Of 28 °F
- Melt-Rates Increase As Season Progresses



MELT RATES

Yellowstone Melt Rates



INTERCEPTION

- **Based on 19 Years of Record at Onion Park**
 - **Maximum Accumulation Of SWE On Canopy Pillow Is 76% Of Maximum Accumulation On Open Pillow**
 - **Melt Rate On Canopy Pillow Is 47% Of Open Pillow**
 - **Canopy Pillow Melts Out 10 Days After Open Pillow**
 - **Maximum SWE Occurs On Canopy Pillow 4 Days After It Does On Open Pillow**

MODEL ADJUSTMENTS

- Many Montana Watersheds Are 70 to 80% Forested
- Data Sites Are Located In Open Areas
- Models Need To Account For Differences Between Open And Forested
- Different Species Have Different Interception
- Different Ages of Same Species Have Different Interception
- Temperature-Based Melt Rates Are Not The Same Through-Out The Season

NRCS SNOTEL DATA

- **Data From SNOTEL Sites Is For Previous Day**
- **Adjustments Must Be Made For Daily Models**



WSC PAPER

- **Western Snow Conference 2007**
- **Estimating Runoff From Montana Steams**
 - Average Annual Precipitation
 - Average April 1 SWE
 - Average April-July Precipitation
 - Cover Type
 - Fire History
 - HUC
 - Area By Precipitation Zone by Cover Type

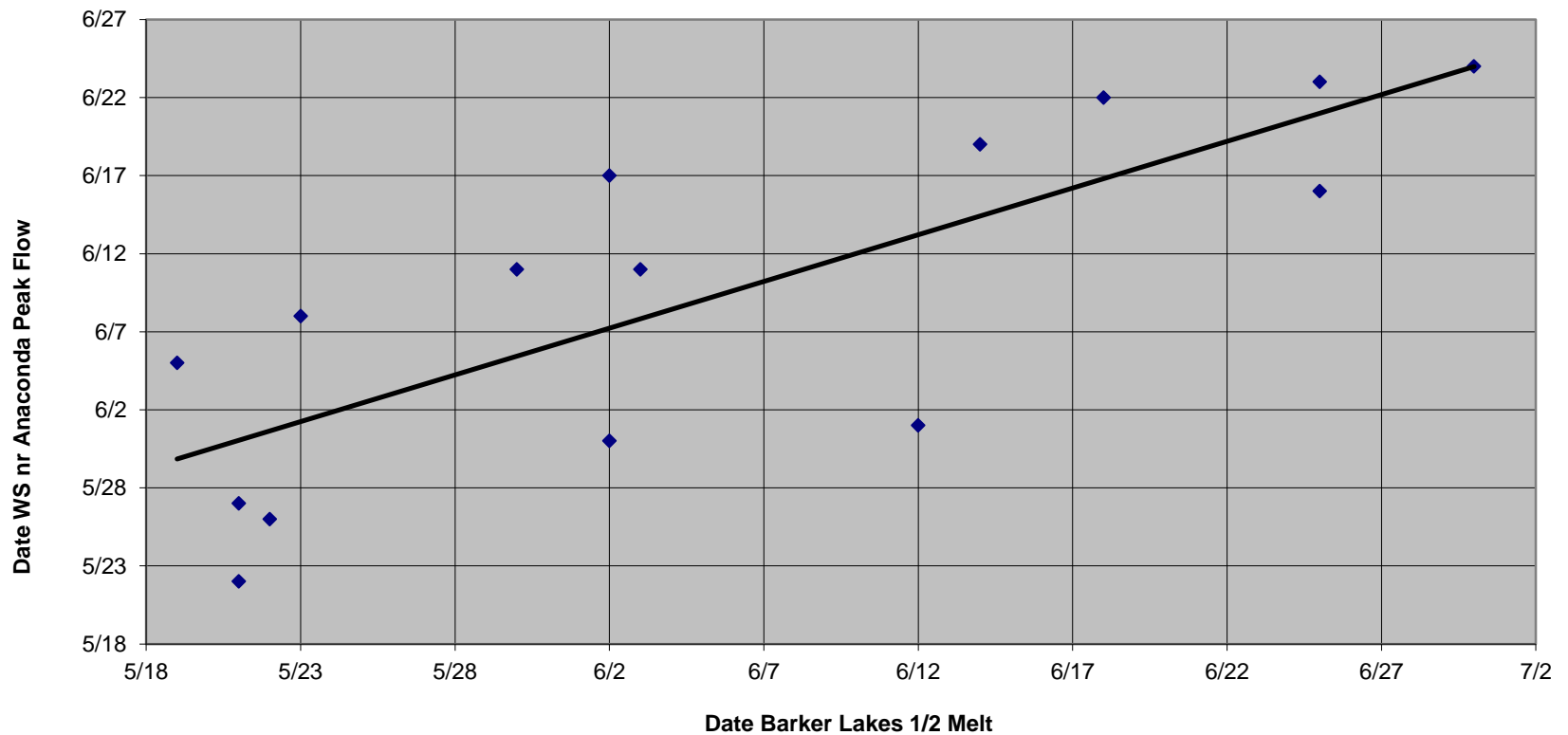
HALF-MELT

- Half-Melt Correlates With Peak Snowmelt
- Zero Melt for Lower Elevation Stations

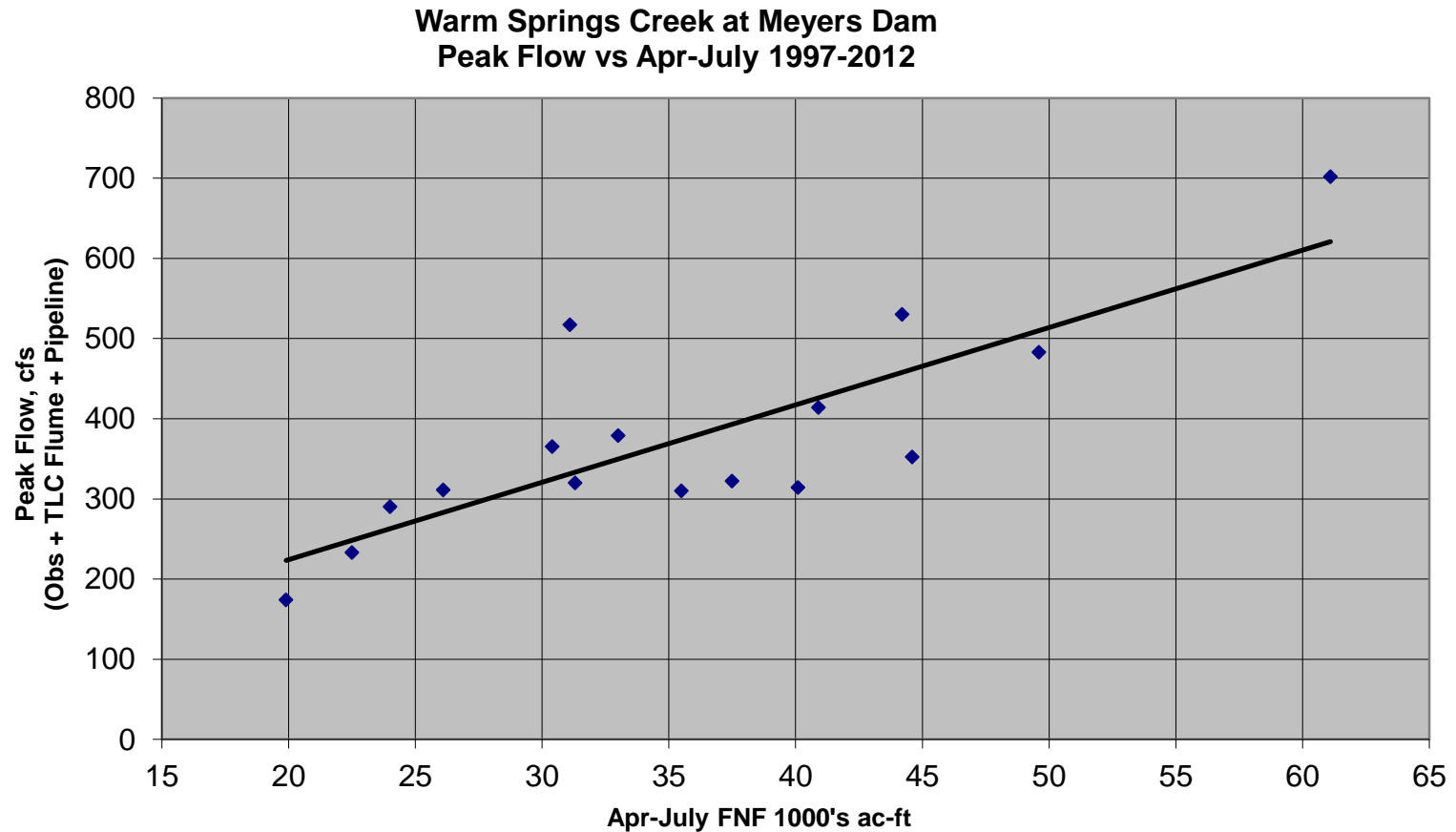


HALF-MELT

Peak Flow Date Warm Springs Creek Near Anaconda vs Barker Lakes 1/2 Melt 1998-2012



PEAK DAILY FLOW





HIGH WATER

**Native Americans Consider High Water To Be
Over When Wild Roses are In Bloom**

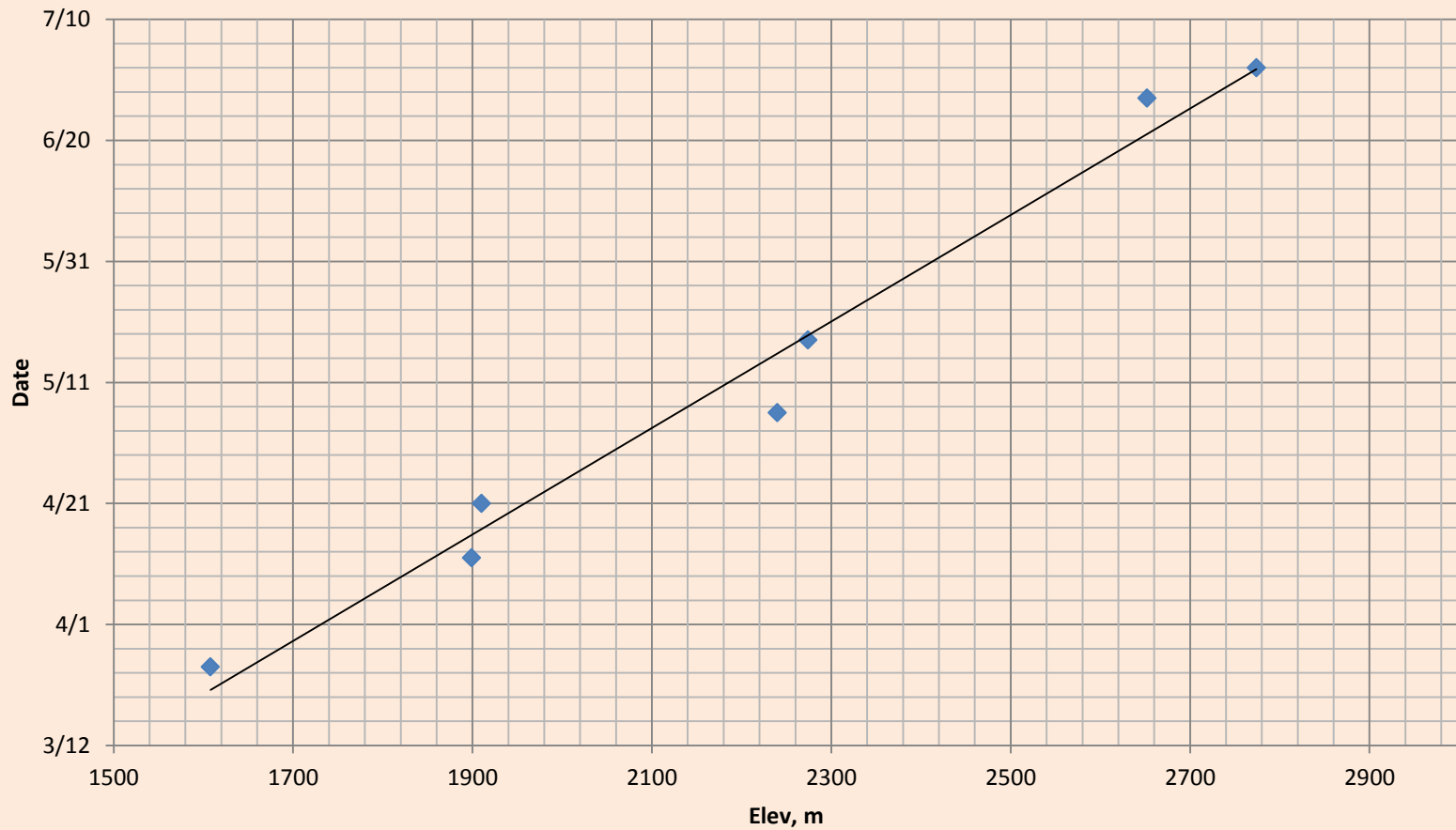
**They Also Say That They Have Seen The
Yellowstone River Dry At Livingston But The
Gallatin River Always Has Water**

GROWING DEGREE DAYS

- Biological Zero Considered To Be 41 °F
- GDD Equals Tavg Minus 41 °F
- Zero Or Negative Values Are Deleted
- Grasses Break Dormancy After Three Consecutive Days With Tavg above 41 °F and Snow Has Melted
- Trees Break Dormancy After Three Consecutive Days With Tavg above 41 °F
- Growing Season Ends When Tmin is 22 °F or Lower
- Growing Season Is Number Of Days Between Break Dormancy And End Of Growing Season
- Fall Green-up Important For Wildlife

PHENOLOGY

1981-2010 AVERAGE DATE GRASSES BREAK DORMANCY
Northern Range YNP



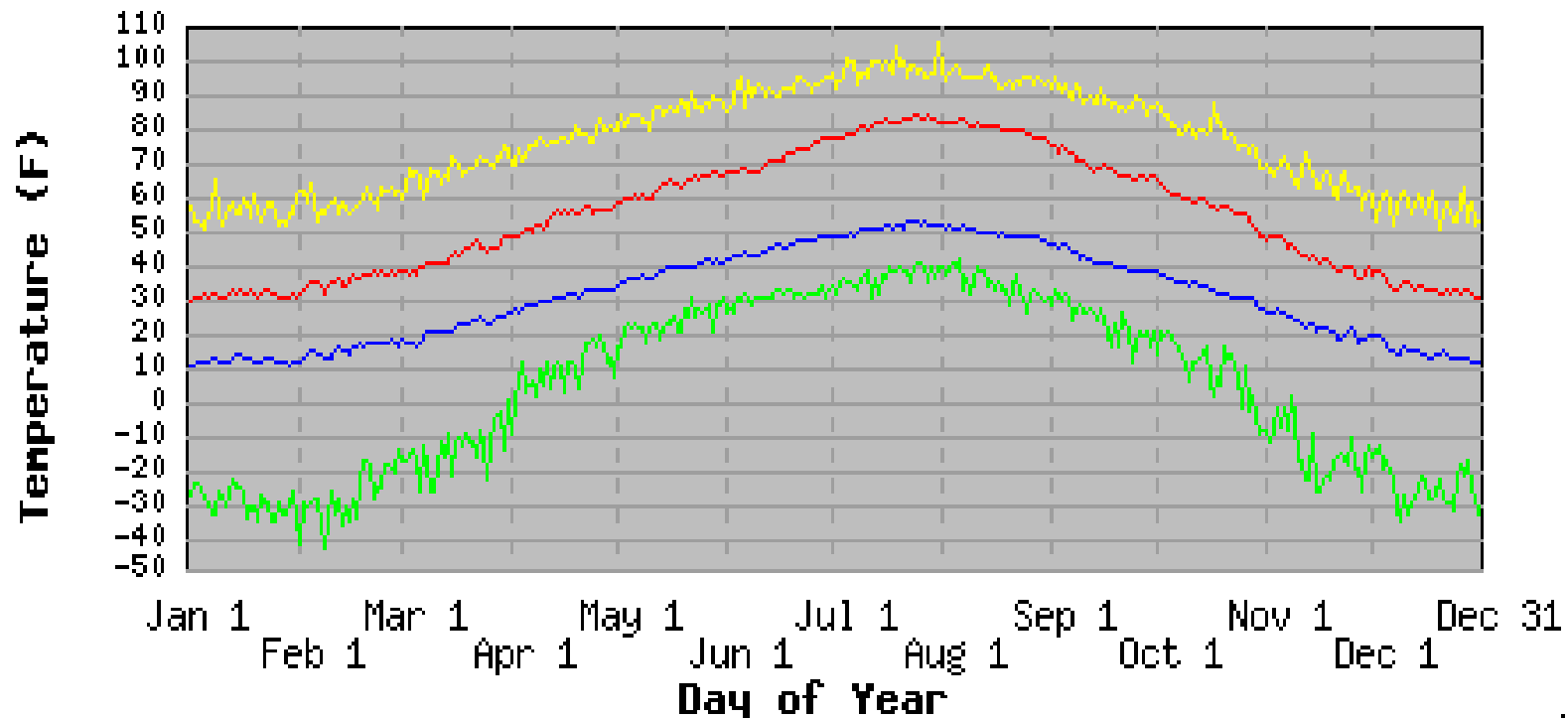
SWSI - Drought

- **Separate Index For Irrigated And Dryland**
- **Separate Irrigated From Natural Streamflow
And Reservoir Storage**

AVERAGES-NOT NORMALS

BOZEMAN MONTANA ST UNIV, MONTANA (241044)

Period of Record : 4/ 8/1892 to 2/26/2012



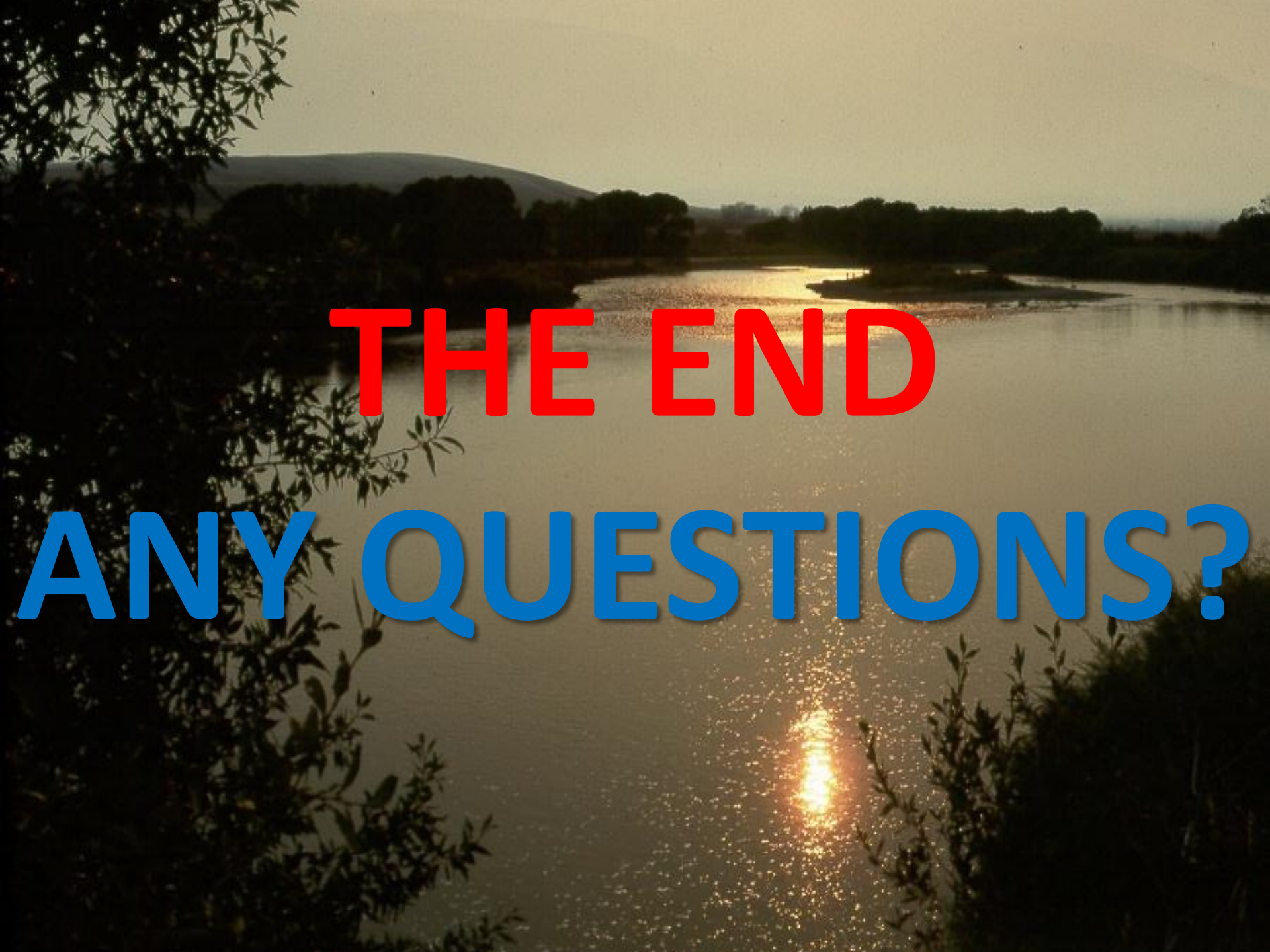
Extreme Max Ave Max Ave Min Extreme Min

Western
Regional
Climate
Center

AVERAGES-NOT NORMALS

- **Historic Daily Temperatures Vary From 60 to 90 Degree's F**

- **Normal's Imply A Small Range Of Values**
- **Average's Imply Some Middle Ground**

A scenic sunset over a body of water, likely a lake or wide river. The sun is low on the horizon, creating a bright, shimmering reflection on the water's surface. The sky is a soft, hazy orange and yellow. In the background, there are dark, silhouetted hills and a line of trees. The foreground is framed by dark, leafy branches on the left and right sides. Overlaid on the image is the text "THE END" in large, bold, red capital letters, and "ANY QUESTIONS?" in large, bold, blue capital letters below it.

THE END

ANY QUESTIONS?